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Analysis of the characteristics and complications of mesiodens with cone beam computed tomography: A retrospective study

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Abstract

Aim: The aim of this study was to investigate the three-dimensional characteristics of mesiodens with Cone-beam Computed Tomography (CBCT) and to analyze the eruption status, direction, shape and complications of mesiodens in pediatric patients.

Material and Methods: In the study, 473 children between the ages of 7-14 years who were diagnosed with mesiodens from the patients who applied to Erciyes University Pediatric Dentistry Department for dental examination between 2012-2020 were evaluated retrospectively. CBCT images of 122 mesiodens from 94 patients who met the inclusion criteria were analyzed. Demographic indicators, the number of mesiodens, crown shape, position, mesiodens eruption status, eruption direction, and dentition stages of the patient were recorded in patients with mesiodens. Clinical complications caused by mesiodens (diastema, eruption delay, rotation, hyperplastic follicle, cyst, root resorption) and their positions in the sagittal, frontal and axial planes were classified.

Results: The mean age of patients with mesiodens was 8.75(%1.92) years and 22 (%23.40) of the patients were female and 72 (%76.60) were male. The percentages of patients with 1 and 2 mesiodens were 70.21, 29.79%, respectively. None of the patients had three or more mesiodentes. Of the 122 mesiodentes examined, 95 were conical and conical mesiodens was the most common (77.90%). When the directions of the mesiodens were examined according to their shapes, it was seen that the conical mesiodentes were positioned more inverted (n=30) and those with tubercles were positioned vertically (n=15) ($p<0.05$). Type 3 mesiodens (impacted and in contact with the central incisor) (n=65,53.30%), evaluated in the sagittal plane, was found to cause more rotation ($p<0.05$).

Discussion: Mesiodentes are difficult to diagnose, especially when they are impacted, and can be overlooked in routine clinical dental examinations. In cases where they are not diagnosed, they can cause orthodontic problems. It is necessary to increase the awareness of dentists about mesiodens, especially when examining pediatric patients.

Keywords
Cbct, Mesiodens, Characteristics

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Introduction

Supernumerary teeth are defined as "non-erupted or erupted teeth or tooth-like structures in addition to 20 primary and 32 permanent teeth" [1]. The etiology of supernumerary teeth is multifactorial because it is caused by both genetic and environmental factors [1]. The presence of fewer or more teeth is due to the effects of the maturation period [2]. There are many theories of supernumerary tooth formation, and the most common is the theory of hyperactivity of the dental lamina [2]. Supernumerary teeth can be classified according to their location (topography) in the dental arch. Supernumerary teeth located between the maxillary anterior incisors are termed mesiodens as the most prevalent form of supernumerary teeth [3]. It was reported that the prevalence of mesiodens in primary dentition is between 0.3-0.8%, while in primary dentition is between 0.1-3.8%. Mesiodentes are more common in males than in females, and they may be found in more than one, remain embedded, and usually do not cause symptoms [4]. Asymptomatic mesiodens is recognized as a result of routine clinical and radiological examination and may lead to many complications such as delayed eruption, tooth displacement, diastema, pain, and swelling in the relevant area, pathological root resorption in adjacent teeth, and cyst formation [2, 4, 5].

Radiographic examinations are of great importance in the diagnosis, differential diagnosis and examination of complications caused by mesiodens. Panoramic radiographs can be used in the diagnosis of mesiodens, but since the anterior region evaluation is insufficient in panoramic radiographs, more detailed examinations are needed [6]. Periapical and occlusal radiographs are helpful in more detailed examination, but conventional radiographic methods are two-dimensional and provide limited information. It is known that mesiodens cause various complications and may remain impacted. For this reason, it is recommended to use advanced imaging techniques for the three-dimensional evaluation of the surrounding anatomical structures and pathologies associated with the mesiodens [7]. Cone-beam computed tomography (CBCT) provides a high-resolution three-dimensional imaging of the bone structures of the head and neck region and has become widespread in dentistry due to its relatively low radiation dose [8].

In this study, it was aimed to evaluate the prevalence of mesiodens in children admitted to the Department of Pediatric Dentistry, Faculty of Dentistry of Erciyes University, and to examine the age and gender distribution of mesiodens, eruption status, direction, shape and complications by cone beam computed tomography.

Material and Methods

Ethics committee approval for this study was obtained from Erciyes University Clinical Research Ethics Committee (2023-199).

In this retrospective study, 473 pediatric patients aged 7-14 years who were diagnosed with mesiodens and had panoramic radiographs, who were admitted to Erciyes University Faculty of Dentistry, Department of Pediatric Dentistry between 2012 and 2020 were included. Of these patients, 109 pediatric patients who underwent CBCT scans were identified.

Criteria for exclusion from the study:

*scans of insufficient anterior maxilla and nasal cavity

*Scans with poor image quality that do not allow for review

*patients with syndromes that may be associated with the presence of supernumerary teeth (Cleft lip/palate, Williams and Gardner syndrome, Cleido cranial dysplasia, etc.)

CBCT images of 125 mesiodentes from 94 patients who met the inclusion criteria were analyzed.

Images were analyzed using a Dell Precision T1500 WorkStation (Dell D02M, Poland) and a 19-inch resolution, 1920x1080 pixel Dell monitor (Dell E190S, China). The measurements described below were recorded in DICOM format with the special computer software NNT (NNT Software, V9.01, New Tom, Italy) the Newton 5G CBCT device.

In this study, the presence of an extra tooth or tooth-like structure in the region between the long axis of the two maxillary central teeth was considered as mesiodens. Demographic information such as age, gender, mesiodens number, shape (conical, supplemental, tubercular), tooth position (horizontal, vertical, invert, mesioangular, distoangular), mesiodens eruption status (embedded, erupted), mesiodens eruption direction and dental examination information such as the dentition period of the patient (primary, mixed, permanent) and finally the complications caused by the mesiodens (diastema, eruption delay, rotation, hyperplastic follicle, cyst, root resorption) and their positions in 3 planes (sagittal, frontal and axial) were classified.

To minimize variability, our research assistant (E.G. and G.D.) with 3 years of experience working in our department reviewed frontal, sagittal, axial and cross-sectional CBCT scans. The control of the scans examined was done by a faculty member (E.K. and K.K) who has 12 years of clinical experience in our department. Different results were re-evaluated by the observers and common conclusions were reached. An inter-research kappa compatibility test was performed, and since the number of observers was more than 2, this value was calculated as 0.84 using 'Fleiss' kappa coefficient' [9]. In the classification made by Fleiss, a Kappa value of 0.75 and above indicates excellent compatibility [10].

CBCT analysis of mesiodens position

In this study, the positions of mesiodentes in three-dimensional planes were investigated. First, the classification defined by Kim et. al [11] was modified by Goksel et al. to classify the 3D positions of the mesiodens and this classification was used in our study.

Mesiodentes were examined in 3 planes according to the following criteria:

•In the frontal plane: the mesiodistal positions of the mesiodens were examined.

Type A= straight, long axis and no inclination.

Type B= crown in midline, root in distal.

Type C= root in midline, crown in distal.

•In the sagittal plane; The superior-inferior positions of the mesiodens were examined.

Type 1 = fully erupted.

Type 2= partially erupted.

Type 3= impacted and in contact with the central incisor.

Type 4= impacted and not in contact with central incisor.

Type 5 = in contact with the nasal cavity,
Type 6 = in contact with the nasal septum.
•In the axial plane; The anteroposterior positions of the mesiodens were examined.
Type A = labial to the dental arch
Type B= in line with the dental arch
Type C= anterior to the nasopalatine canal, in contact with the nasopalatine canal
Type D= behind the nasopalatine canal, in contact with the nasopalatine canal
Type E = behind the nasopalatine canal, not in contact with the nasopalatine canal

Statistical analysis

The study was evaluated with the IBM SPSS Statistics 23 (SPSS Inc., Chicago, IL, USA) package program. Number, percentage, mean and standard deviation were used as descriptive statistical methods in the evaluation of the data. The relationship between the categorical variables was investigated with the Chi-Square Test, and the strength of the significant relationship between the groups was determined using Cramer's V correlation coefficient.

Ethical Approval

Ethics Committee approval for the study was obtained.

Results

The mean age of the study patients was 8.75 (1.92%) years. Of the patients, 72 (76.60%) were male and 22 (23.40%) were female. The ratio of the gender to each other was 3.2:1.

A total of 122 mesiodentes were detected, including 66 (70.21%) single mesiodentes and 28 (29.79%) double mesiodentes. None of these patients had three or more mesiodentes. Of the 122 mesiodentes s examined, 95 were found to be the most common conical shape (77.90%).

Other mesiodentes weree tubercular (n=24, 19.70%) and supplemental (n=3, 2.50%). When the directions of the mesiodentes were examined according to their shapes, it was seen that the conical mesiodens was positioned more inverted (n=30) and those with tubercles were positioned vertically (n=16). The majority of mesiodentes were diagnosed in the mixed dentition (n=106, 86.90%), with 13 in the permanent dentition (10.70%) and 3 in the primary dentition (2.50%). Types of complications caused by mesiodens are shown in Table 1.

It has been identified that the number of mesiodentes causing rotation, eruption delay and root resorption in the relevant teeth is 1 (0.80%), the number of mesiodentes causing the eruption delay, rotation, the hyperplastic follicle is 2 (1.60%), and the number of mesiodens causing the eruption delay, hyperplastic follicle, root resorption is 1 (0.80%). In the 3D CBCT evaluation, the mesiodistal positions in the frontal plane were examined as Type A, Type B and Type C and their numbers were recorded. (Table 1). When mesiodentes were evaluated according to their directions on the frontal axis, it was seen that most of the mesiodentes located horizontally, vertically and inverted were Type A, the mesioangular one was Type B, and the distoangular one was Type C in the Frontal plane.

The superior-inferior positions of the mesiodens in the sagittal plane were examined (Table 1). Accordingly, the most observed position was "Type 3 (buried and in contact with the central breaker)" (n=65, 53.30%).

Most of the mesiodentes whose anteroposterior positions were examined in the axial plane were Type B (n= 87, 71.30%). The numbers and percentages of other mesiodentes are given in Table 1. None of the examined mesiodentes were Type 2 (partially erupted) (Table 1).

When the directions of the mesiodentes were examined according to their shapes, it was seen that the conical mesiodentes were positioned more inverted (n=30) and those with tubercles were positioned vertically (n=15). There is a significant relationship between shape and direction ($p<0.05$) (Table 2).

When Table 3 is examined, it can be seen that teeth with hyperplastic follicles cause more rotation ($p<0.05$). It was determined that Type 3 teeth, which were evaluated in the sagittal plane, caused more rotation ($p<0.05$).

Discussion

In this study, the prevalence of mesiodens was evaluated by cone beam computed tomography in children living in the Cappadocia region. In some studies, it was reported that mesiodens prevalence was more frequent in males than in females with a ratio of 2 [3, 13]. Ersin et al. also found that the mesiodens ratio in males was 3 times higher than in females [14]. Colak et al. reported that the prevalence of mesiodens was higher in females than in males [15]. In our study, the prevalence of mesiodens was found to be higher in males, similar to those reported in the majority of studies.

Anthonappa et al. underline that most of the studies on mesiodens do not refer to "the number of mesiodens observed in a person" [16]. In the study conducted by Gündüz et al., the single incidence of mesiodens was 76.8%, while the double incidence was 23.1% [17]. Kazanci et al. on the other hand, found one mesiodens at a rate of 80% and two mesiodentes at a rate of 20% [18]. In our study, similar to other studies, the probability of single (70%) mesiodens was found to be higher than the probability of double mesiodentes (29.7%). The presence of three or more mesiodentes, which was reported as "rare" in the literature, was not detected in any of the patients included in the study. The high incidence of single mesiodens in our study and the absence of three or more mesiodentes may be due to the fact that syndromic individuals were not included both in this study and in other studies.

When mesiodentes are examined in terms of their morphology, the number of "conical-shaped" mesiodentes is higher [13, 19, 20]. In our study, conical shaped mesiodens was found to be the most common with a rate of 77.90%, similar to the literature.

When assessing the position of mesiodens in the study by Mukhopadhyay et al., 62.8% vertical and 30.8% inverted mesiodentes were reported [21]. In a study by Gunduz et al., positions of mesiodentes were vertical in 55.2%, inverted in 37.6% and horizontal in 7% [17]. Similar to the studies reported in this study, the highest rate of mesiodentes was found in the vertical position (45.9%).

In the study by Ersin et al., 4.2% of the mesiodentes examined were observed in the primary, 87.5% in the mixed dentition, and 8.3% in the permanent dentition [14]. The majority of mesiodentes examined in our study were in patients with mixed

dentition (86.90%). We assume that this is due to the fact that the age groups of the patients included in the study were similar, and the study was conducted in the pedodontics clinic. In the study by Ramesh et al., it was stated that 55% of the mesiodentes erupted, 18% were half-impacted, and 27% remained impacted [22]. In our study, 113 (92.60%) of the examined mesiodentes were impacted. Tomography is requested for pediatric patients only in cases where there is difficulty in the diagnosis and treatment planning in the clinic and in surgical interventions. Elapsed, asymptomatic mesiodens

Table 1. Demographics variables of mesiodens.

		Min	Max	Mean		Standard Deviation
Age		5	14	8.65		1.92
Variables					N:Number of Mesiodens	Percentage%
Dentition	Primar				3	2.50
	Mix				106	86.90
	Permanent				13	10.70
Diastema	Present				15	12.30
	None				107	87.70
Eruption delay	Present				43	35.20
	None				79	64.80
Rotation	Present				20	16.40
	None				102	83.60
Hyperplastic Follicle	Present				7	5.70
	None				115	94.30
Cyst	Present				4	3.30
	None				118	96.70
Root Resorption	Present				3	2.50
	None				119	97.50
Complication Type	None				51	41.80
	Diastema				10	8.20
	Diaestema, Eruption delay				1	0.80
	Diaestema, Eruption delay, Root Resorption				1	0.80
	Diaestema, Rotation				3	2.50
	Eruption delay				31	25.40
	Eruption delay, Rotation				4	3.30
	Eruption delay, Rotation, Hyperplastic Follicle				2	1.60
	Eruption delay, Hyperplastic Follicle, Root Resorption				1	0.80
	Eruption delay, Cyst				3	2.50
	Rotation				9	7.40
	Rotation, Hyperplastic Follicle				2	1.60
	Hyperplastic Follicle				2	1.60
	Cyst				1	0.80
	Root Resorption				1	0.80
Frontal	Type A: Straight, longitudinal and inclined				68	55.70
	Type B: Crown in the midline and root distal				28	23.00
	Type C: Root in the midline and crown distal				26	21.30
Sagittal	Type 1: Full Eruption				9	7.30
	Type 2: Partial Eruption				0	0
	Type 3: Embedded and in contact with the Central breaker				65	53.30
	Type 4: Embedded and not in contact with the Central breaker				42	34.40
	Type 5: In contact with the nasal cavity				4	3.30
	Type 6: In contact with the Nasal Septum				2	1.60
Axial	Type A: Labial of the dental arch				2	1.60
	Type B: Inside the dental arch				87	71.30
	Type C: Anterior to the nasopalatine canal and in contact				29	23.80
	Type D: Behind the nasopalatine canal and in contact				2	1.60
	Type E: nasopalatine is behind the channel and not in contact				2	1.60

Table 2. Relationship between shape and direction of mesiodens.

Direction							
Chape	**Horizontal (%)**	**Vertical (%)**	**Invert (%)**	**Mesioangular**	**Distoangular**	**p<0.05**	**Cramer's V**
Conic	18(94.74)	21(56.75)	30(96.77)	5(83.33)	1(100.00)	0.003*	0.35
Tuber	0	15(40.54)	1(3.23)	1(16.66)	0		
Sup	1(5.26)	1(2.70)	0	0	0		

Table 3. Relationship between rotation of mesiodens in Sagittal Plane and Hyperplastic Follicle.

Sagittal							
Rotation	**Type 1**	**Type 3**	**Type 4**	**Type 5**	**Type 6**	**p-value**	**Cramer's V**
Present	2(66.66)	7(13.21)	4(11.76)	4(100.00)	1(50.00)	0.001	0.43
None	1(33.33)	46(89.79)	30(88.24)	0	1(50.00)		
Hyperplastic Follicle							
Rotation	**Present**	**None**				**p-value**	**Cramer's V**
Present	4(57.10	16(13.90)				0.003	0.27
None	3(42.90)	99(86.10)					

and routine examinations are performed with panoramic and periapical films. The evaluation of tomography within the scope of the study may be effective in finding these results in our study.

Mesiodens can cause midline diastema, crowding, delay or obstruction in the eruption of central incisors, rotation, root resorption, and dentigerous cyst formation [11]. Kim et al. found that the most common complication related to mesiodens was delayed eruption of permanent central incisors (56.4%) [11]. However, Shih et al. reported the most common complication related to the mesiodens as midline diastema and determined the root resorption of the adjacent tooth to be 1.5% [10]. In the mesiodens examined in this study, maxilla midline diastema (12.30%), eruption delay in adjacent teeth (35.20%), rotation in adjacent teeth (16.40%), cyst (3.30%) or hyperplastic tooth follicle formation (5%) and complications such as root resorption (2.50%) in the associated teeth were observed. The results of our study support the results of Kim et al.'s study.

In our study, mesiodentes were examined in three planes. As a result, it was determined that most of the mesiodentes were located between the midlines of the central teeth, straight and uninclined in the long axis, positioned in the axial dental arch and in contact and impacted with the central teeth in the sagittal direction. Mukhopadhyay et al. reported 2.6% labial mesiodentes [21]. However, Kim et al. found that none of the mesiodens was labial to the dental arch [23]. In this study, a labial mesiodens was determined albeit less (1.6%), according to the results of study by Aoun et al., they reported that 20.5% of the mesiodentes were in contact with the base of the nose, and 49% with the nasopalatine canal [24]. In our study, the mesiodens contacting the nasal cavity was 3.30% and the mesiodens contacting the nasal septum was 1.6%. The low rate of mesiodentes contacting the nasal cavity and nasal septum in our study may be related to the fact that the mesiodens was more in contact with the central teeth in the group studied. In the study group, the fact that the mesiodens was located closer to the oral cavity and located in the arch may have affected the result in this way.

Limitations

Within the scope of this study, it was aimed to evaluate the mesiodens in three dimensions by tomography. However, complications such as being buried were overestimated. For this reason, we think that different results may be encountered in studies with a higher number and in which both panoramic and periapical and tomography are evaluated together.

Conclusion

Mesiodentes are cases that are difficult to diagnose, especially in the case of impact, and can be unnoticed in routine examinations. However, if they are not diagnosed, they can cause orthodontic problems. For this reason, it is important that they are diagnosed early and intervened in the early period to intervene in the complications. In this study, it was provided to evaluate the mesiodens in 3 dimensions in 3 planes and to deal with the complications that may occur. In this respect, we emphasize that this is important for both pediatricians and orthodontists.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

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Conflict of interest

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